

Comet 55P/Tempel-Tuttle and the Leonid Meteors

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The parent comet of the Leonid meteor showers has been observed far less often than the showers themselves. Apart from 43 astrometric observations of the comet from the late 1865 and early 1866 apparition, there were only four astrometric observations in June – July 1965, one observation in October 1699 and a handful of semi-accurate Chinese observations in 1366. Nevertheless, these observations were used to compute the orbit used in the comet's successful recovery in March 1997. The comet's motion, including perturbations from all the planets and the rocket-like thrusting of the outgassing cometary nucleus, was numerically integrated back in time for two millennia and ephemerides were computed for each perihelion return. These ephemerides were then used in an attempt to locate additional ancient observations. There are possible (but not definite) observations of the comet in October 1234 and in January 1035. The Leonid meteors themselves have been observed since AD 902. Prior to the eighth century, no Leonid meteors should have been observable because the comet's orbit passed too far outside that of the Earth. For the same reason, there seems little likelihood that any Leonid meteors will be observable after the twenty first century. Even though there are far more Leonid meteor observations than there are observations of the parent comet, predicting the future Leonid meteor shower events is far more difficult than predicting the comet's future motion. Efforts to predict the intensity of a meteor shower by modeling the stream of particles released by the parent comet is an extremely complex process fraught with unknowns and assumptions. On the other hand, the intensity of the past, observed Leonid shower events has depended critically upon the geometric circumstances. In particular these are the proximity of the parent comet's orbit to that of the Earth and the time interval that the Earth follows or leads the parent comet to its descending orbital node (the close approach point). Using the observed nature of past Leonid showers as a guide for predicting the 1998-99 events, one would expect the shower maxima to occur near the times the Earth passes closest to the comet's descending node. This seems to have been the case for the Leonids seen in 1995, 1996, and 1997. A bound upon the intensity of the 1998-99 events should be provided by the observed intensity of the events in 1866-67 and 1931-32, when similar geometric circumstances were present. The meteor hourly rates in these periods were about 5000 and 200 respectively.